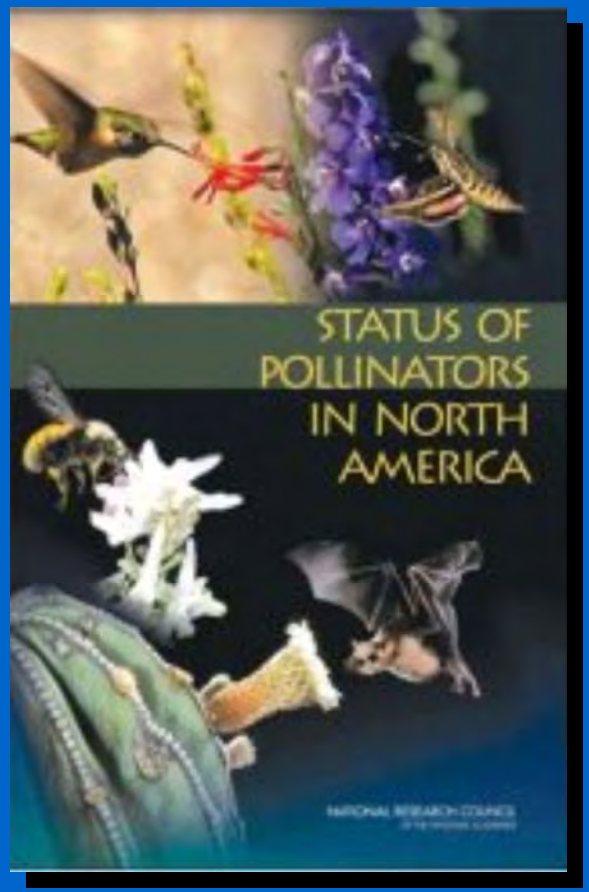
Colony Collapse Disorder (CCD)

affecting honey bee (Apis mellifera) colonies

Dr. Jeff Pettis USDA-ARS Bee Research Lab. Beltsville, Maryland, USA

- *Pollinator decline, Symptoms of CCD*
- *Recent colony losses, research effort and CCD causes*

North America Pollinators



- National Academies of Science
- *Status of Pollinators in North America*
- 2007
- **Pollinators are in decline**

http://www.nap.edu/catalog/11761.html

European Pollinators

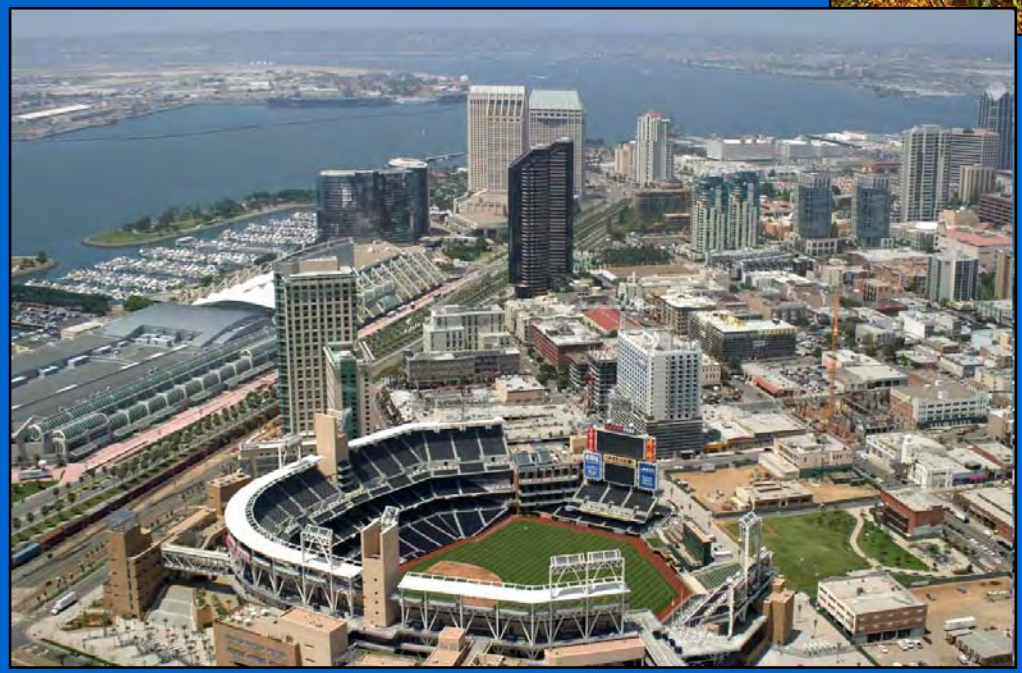
- J. C. Biesmeijer, S. P. M. Roberts, M. Reemer, R. Ohlemler, M. Edwards, T. Peeters, A. P. Schaffers, S. G. Potts, R. Kleukers, C. D. Thomas, J. Settele, and W. E. Kunin

- 21 July 2006 *Science* **313** (5785), 351.[DOI:10.1126/science.1127863]

- **Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands**

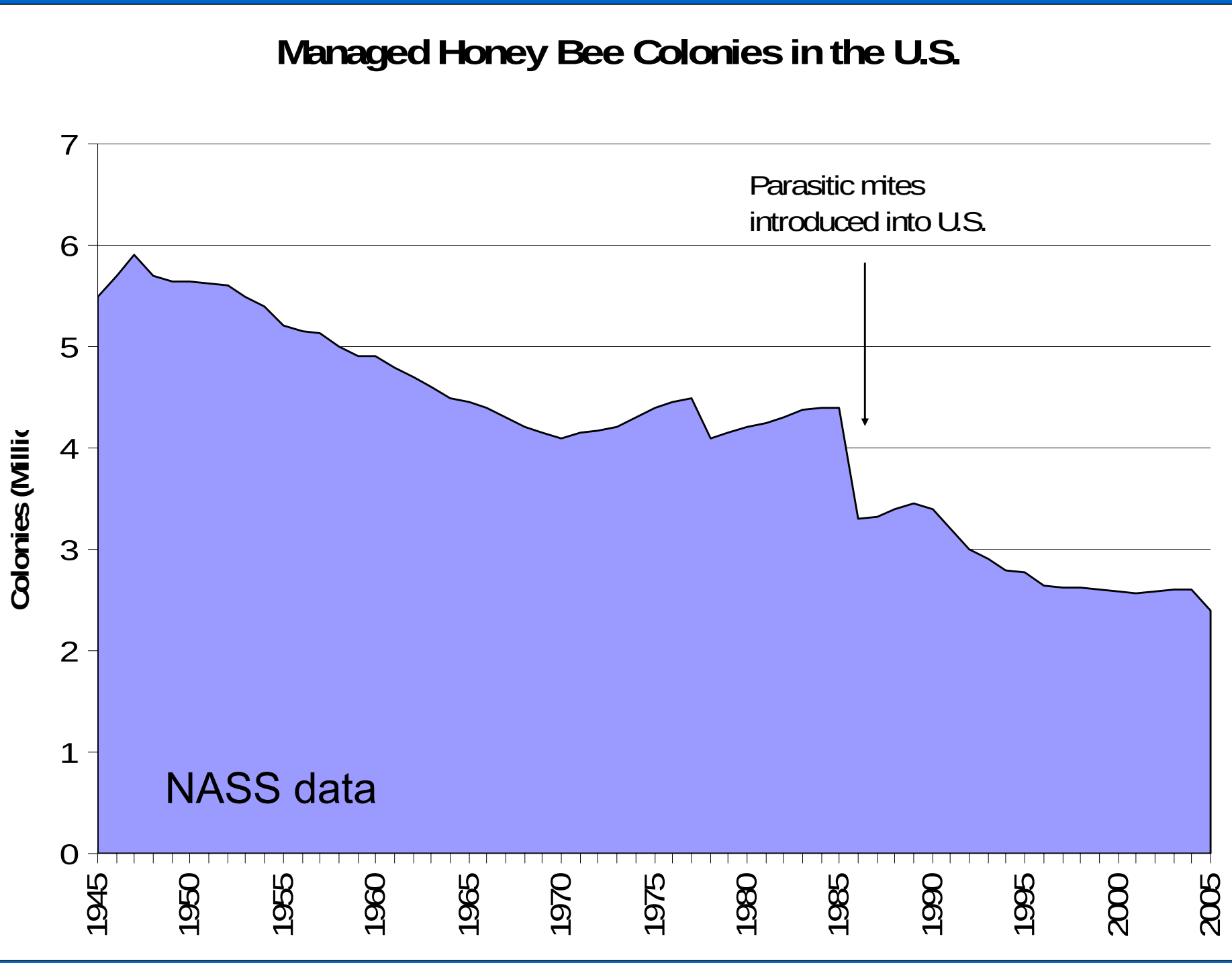
www.sciencemag.org

Pesticides



Habitat destruction
Urbanization

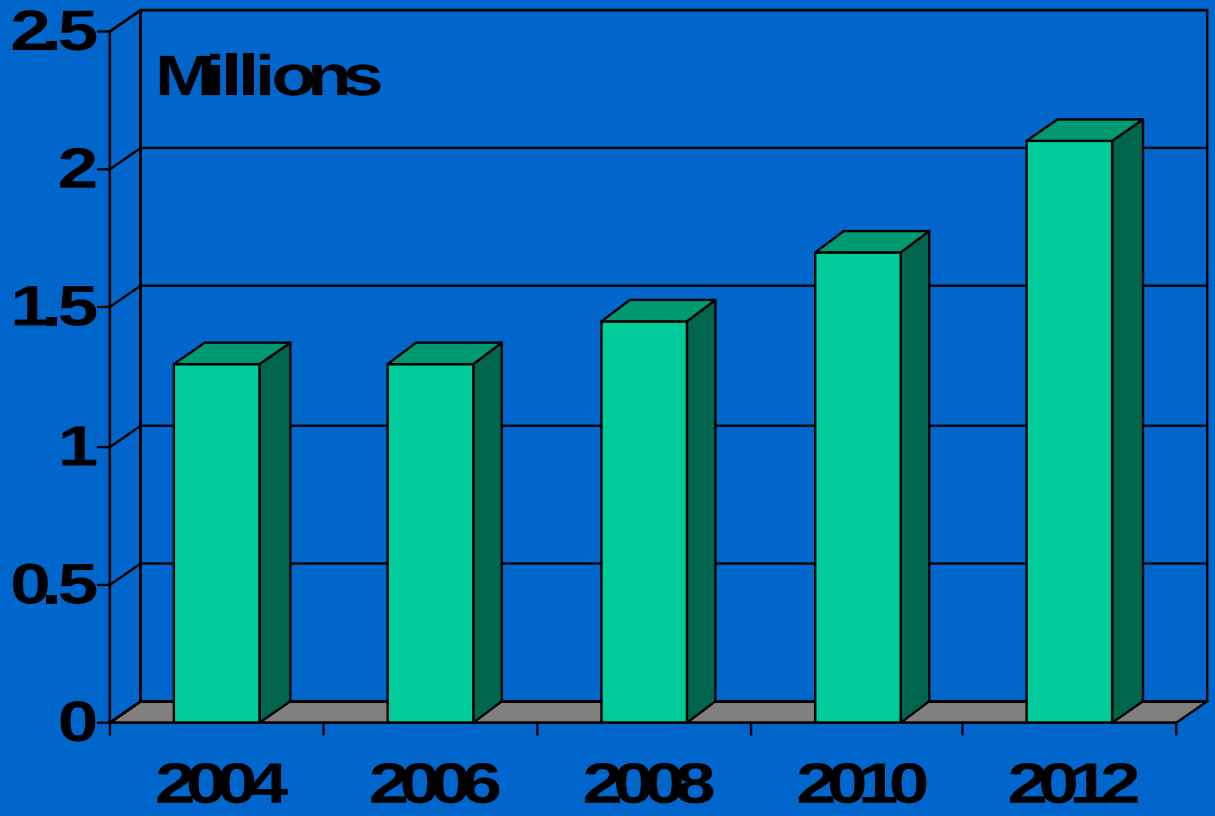
Monocultures


Managed Honey Bee Colonies in the U.S.
Colonies (Millic
7
6
5
4
3
2
1
0
Parasitic mites
introduced into U.S.
NASS data
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

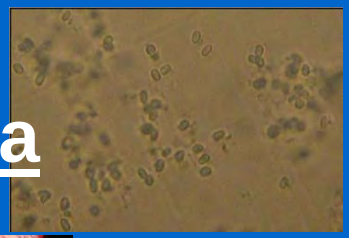
Major Migratory Routes of Honey Bee Colonies

California almonds require 1.2 million honey bee colonies from January through March each year; that represents almost half of all managed colonies In the U.S.

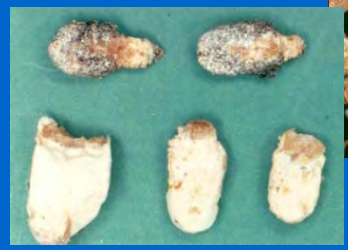
Honey bee colonies needed in California almonds



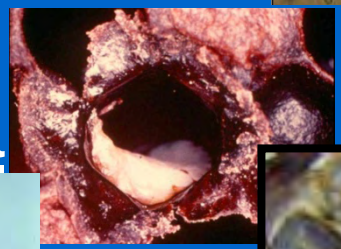
Nosema

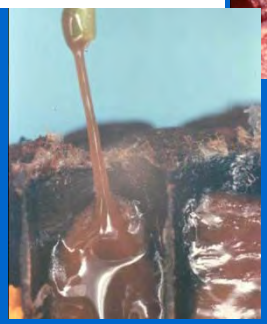


Fungi



Bacteria





Viruses

Parasites

Other Insects

Symptoms of CCD

- Rapid loss of adult worker bees
- Few or no dead bees in colony
- Colonies dead w/ excess brood
- Small cluster w/ queen present
- Pollen and Honey stores intact

Working Hypothesis

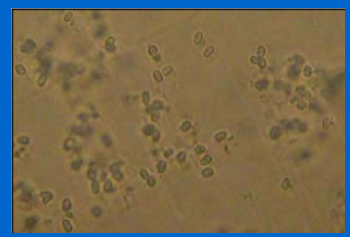
Primary Stress

Varroa mites

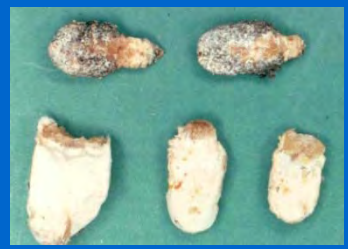
Management
Nutrition
Pesticides

Secondary Pathogen

Viruses



Nosema

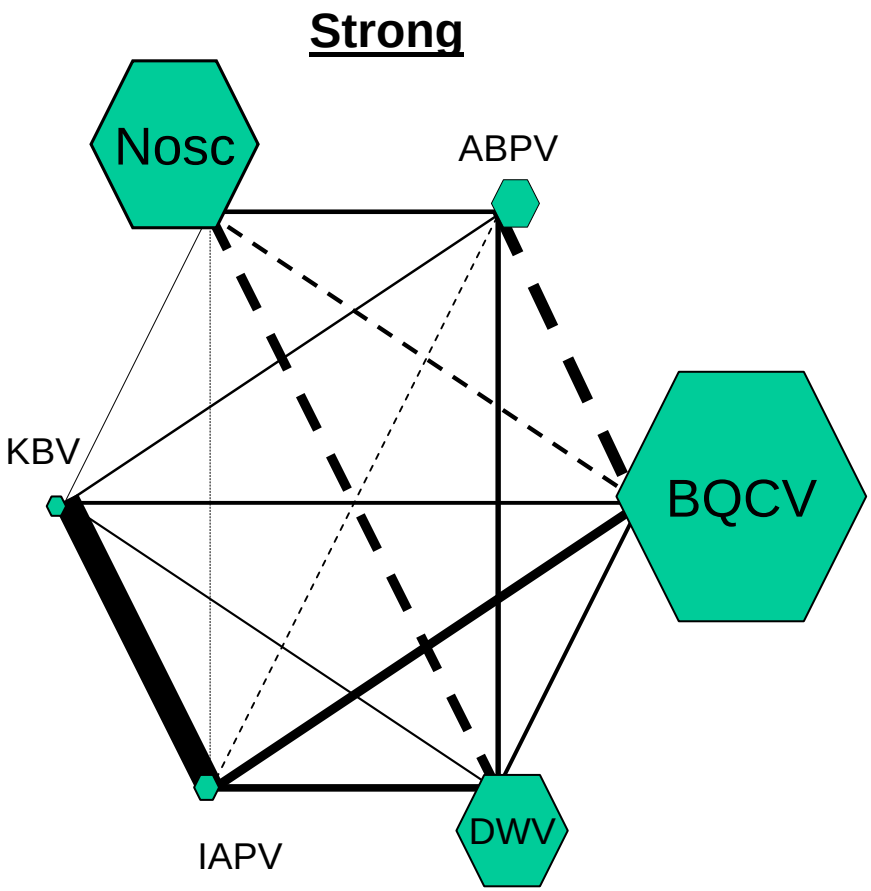


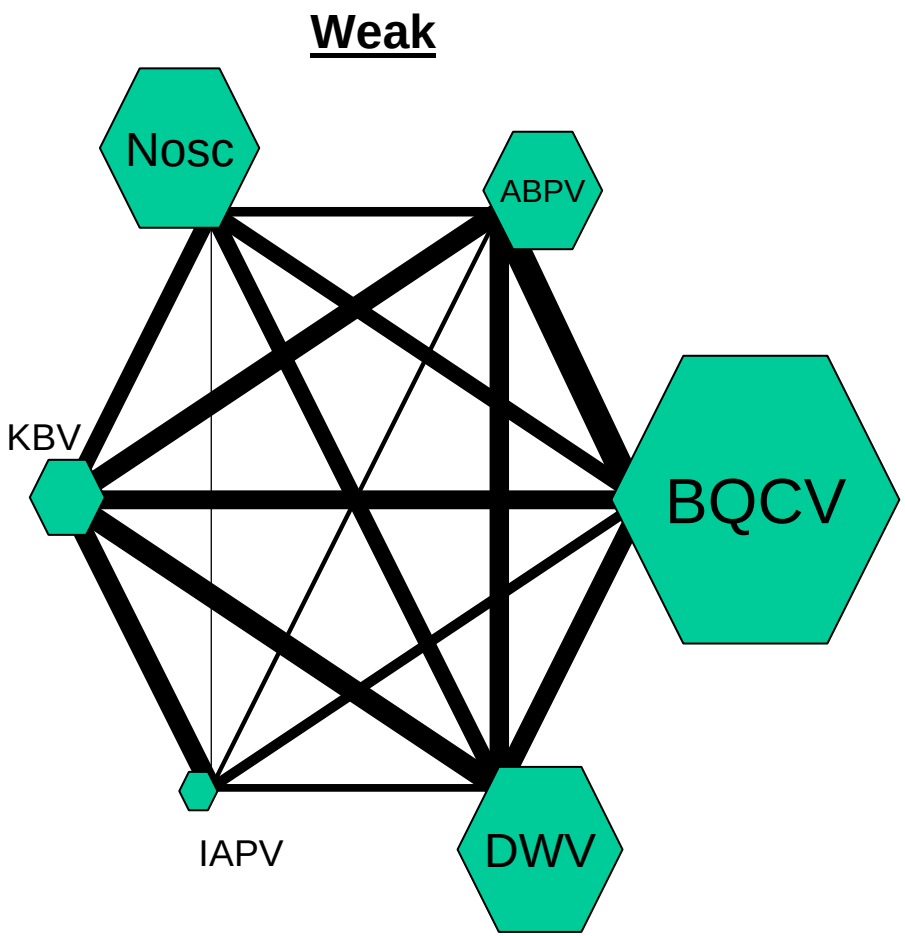
Fungi

Bee Forensics Gene Set – New turbo edition

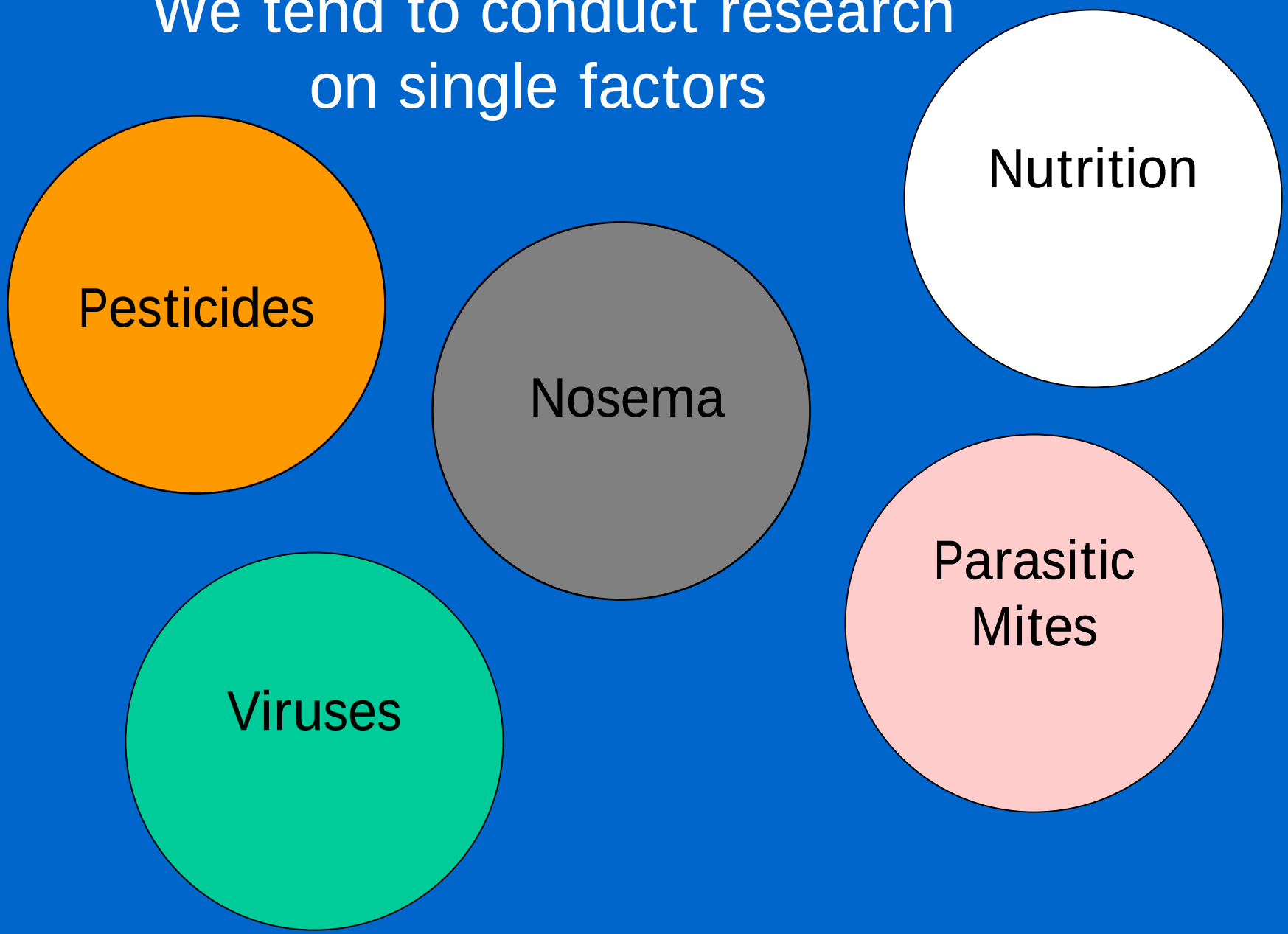
Beetox	Immune Genes	Pathogens	Control
Catalase	Abaecin	A. apis	Am52C8
CEst04	Apidaecin	ABPV	VgMC
CYP306A1	basket	Acawood	Actin (E)
CYP4G11	Bgluc1	Amoeba	RPS5 (E)
CYP6AS14	defensin1	Bact16S	
dnc ortholog	defensin2	BQCV	
GSTS3	dorsal-1	CBPV	
PKA-C1	Dredd	chitinA	
PKA-R1	Dscam	DWV	
rut ortholog	EGFlikeA	FungITS	
	hymenopt	germSA	
	PGRP9710	KBV	
	PGRPLC710	M. Pluton	
	PGRPSC2505	Nosapis	
	PGRPSC4300	Noscer	
	PPOa	SBV	
	tab	Spapis	

Pathogen Loads and Covariance

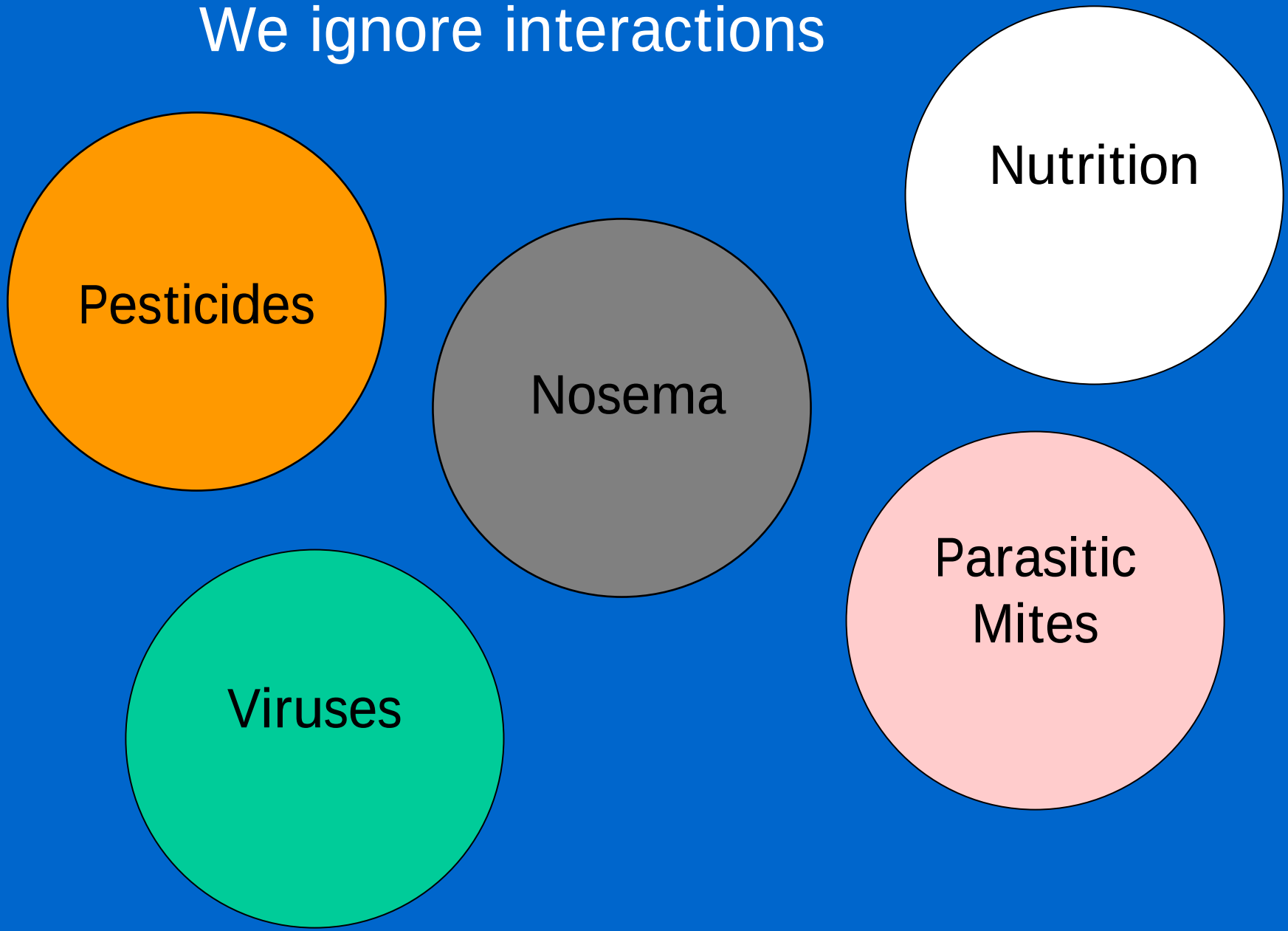




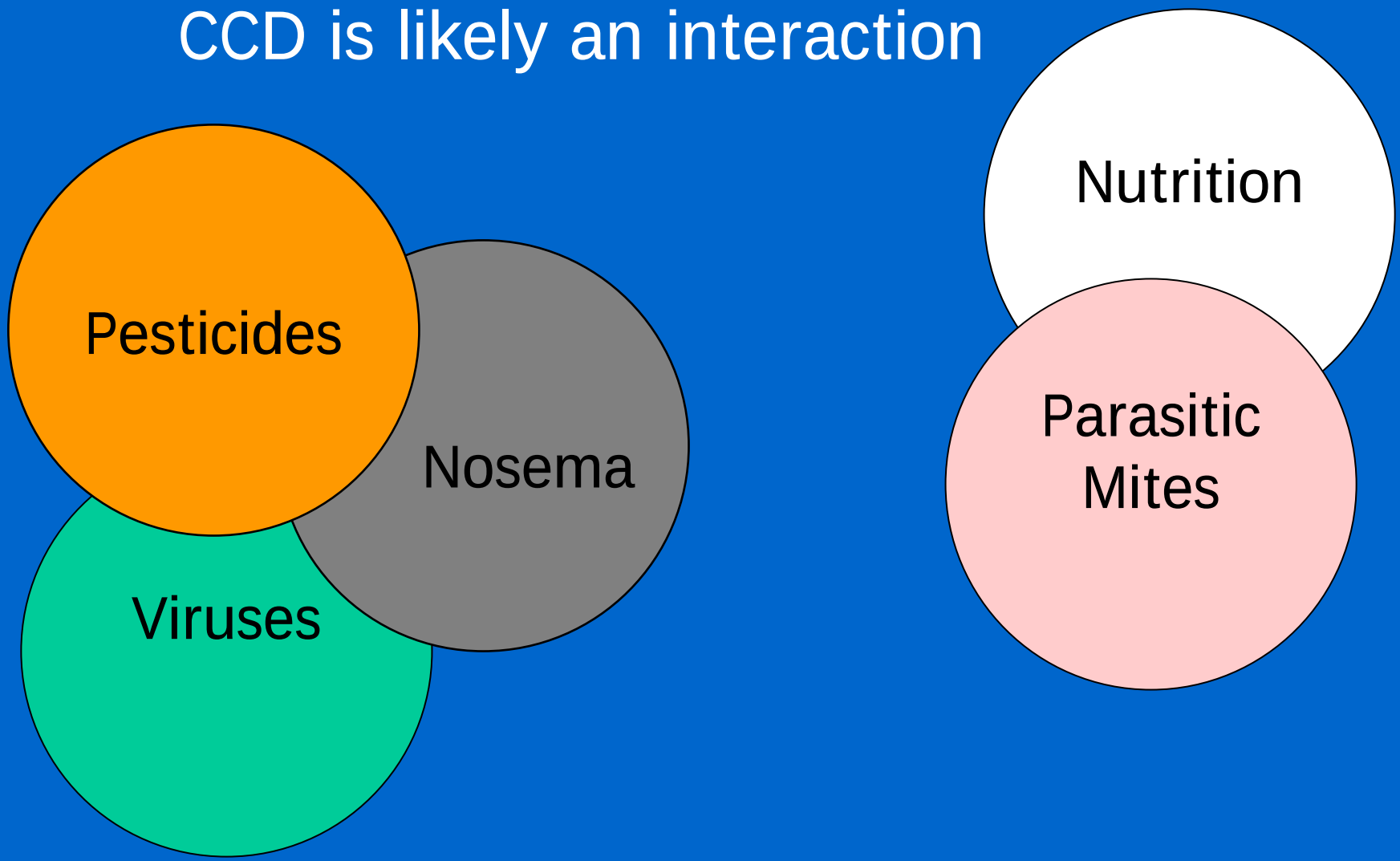
We tend to conduct research on single factors



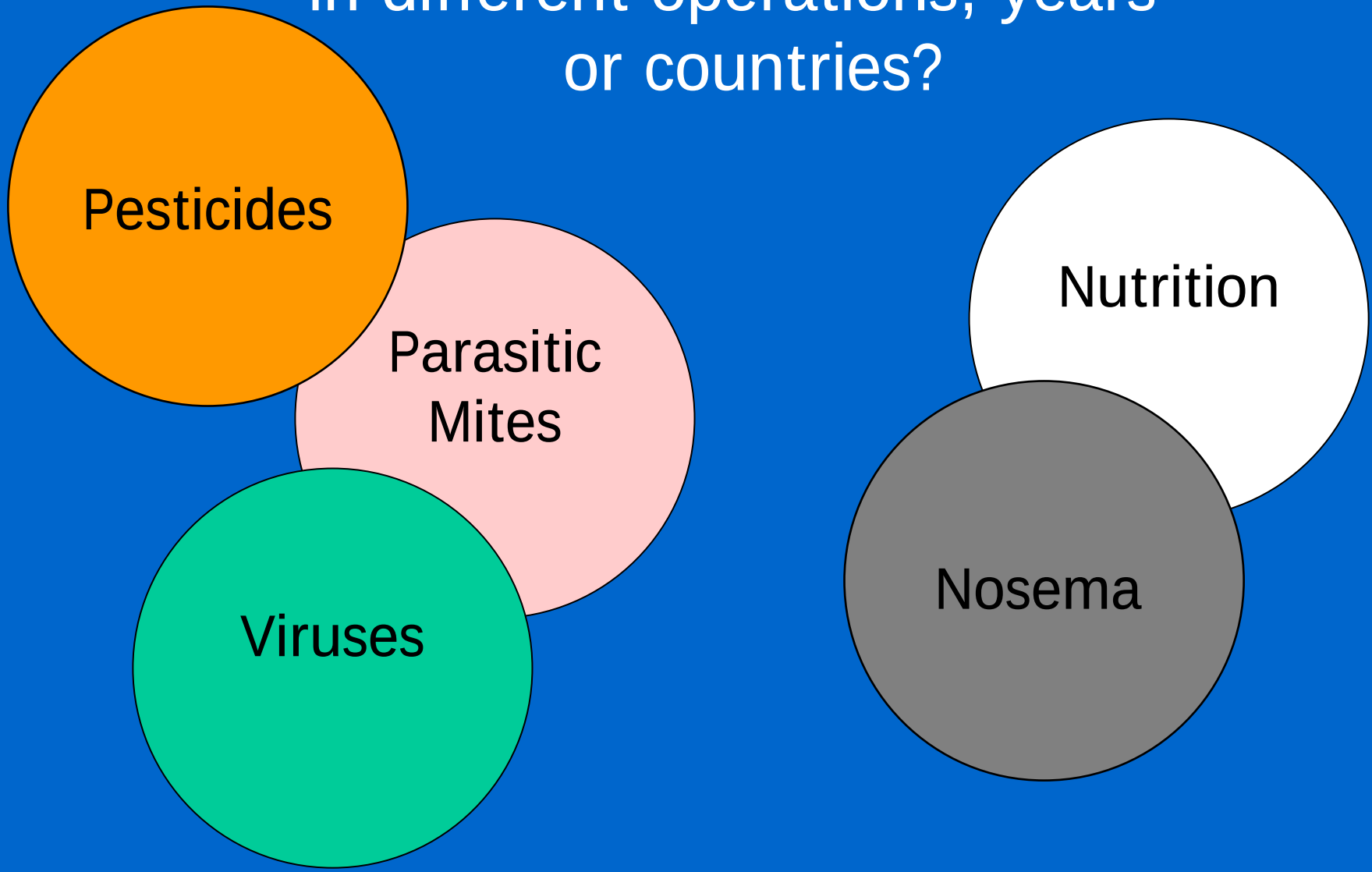
We ignore interactions



CCD is likely an interaction

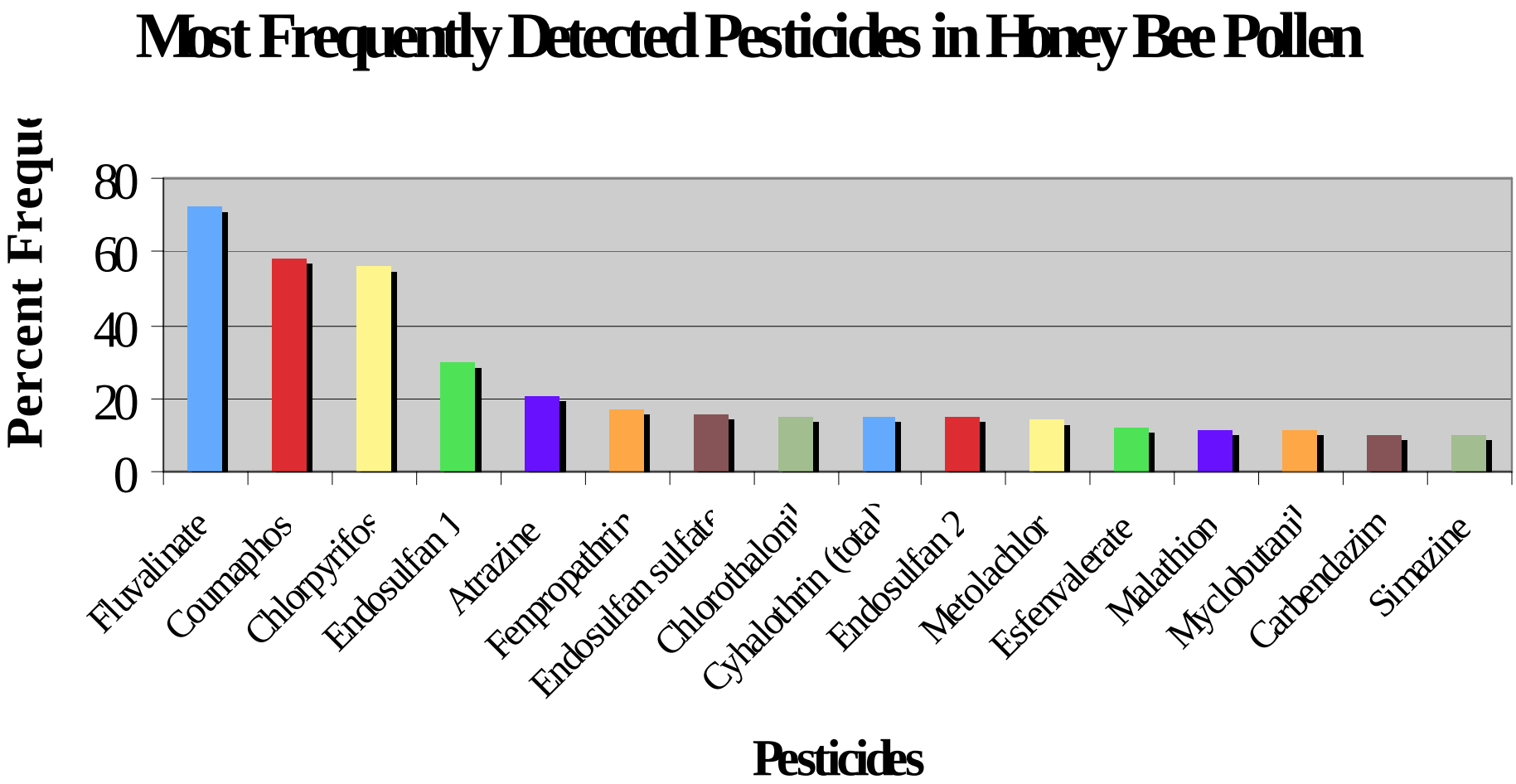


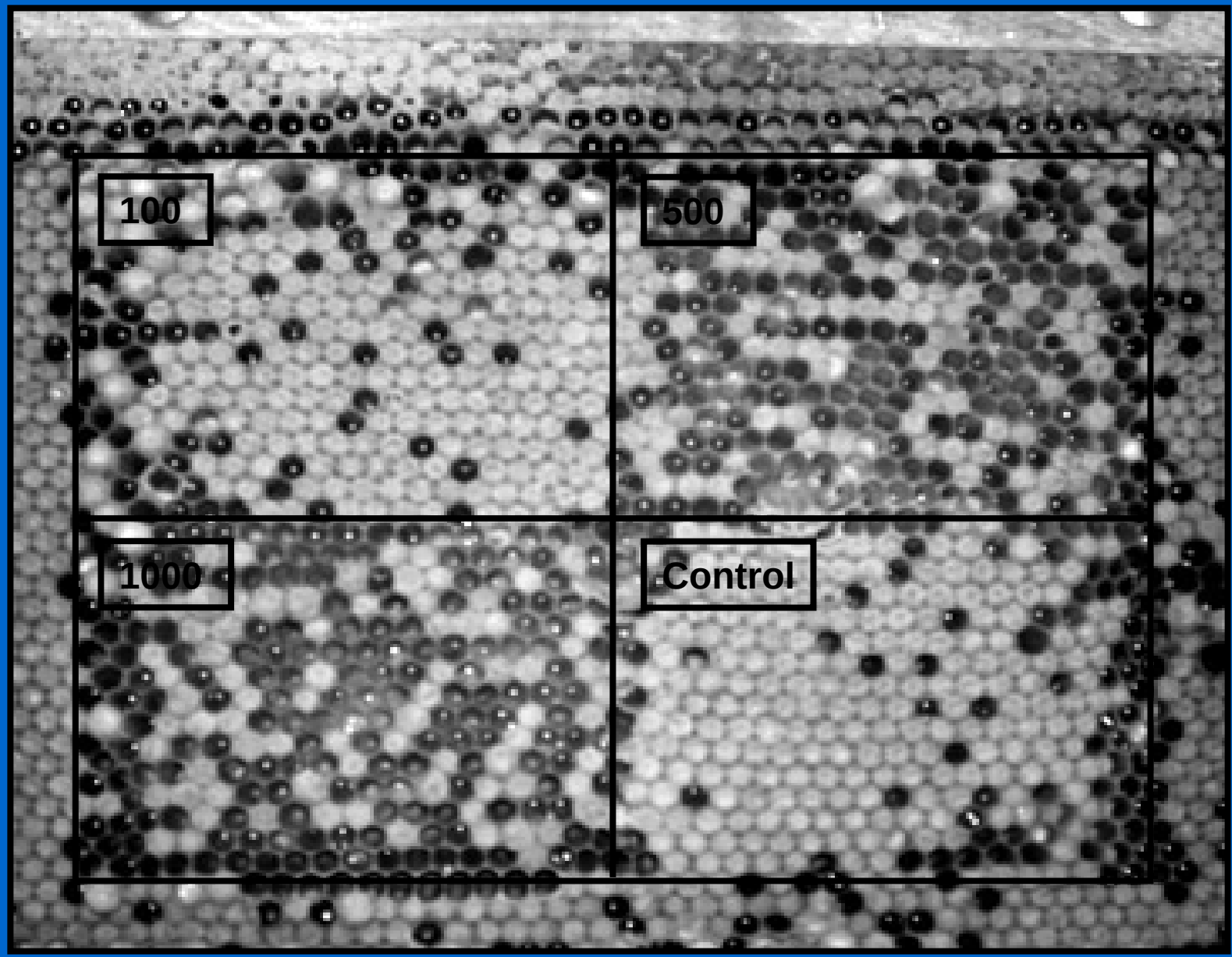
Interactions could be different in different operations, years or countries?



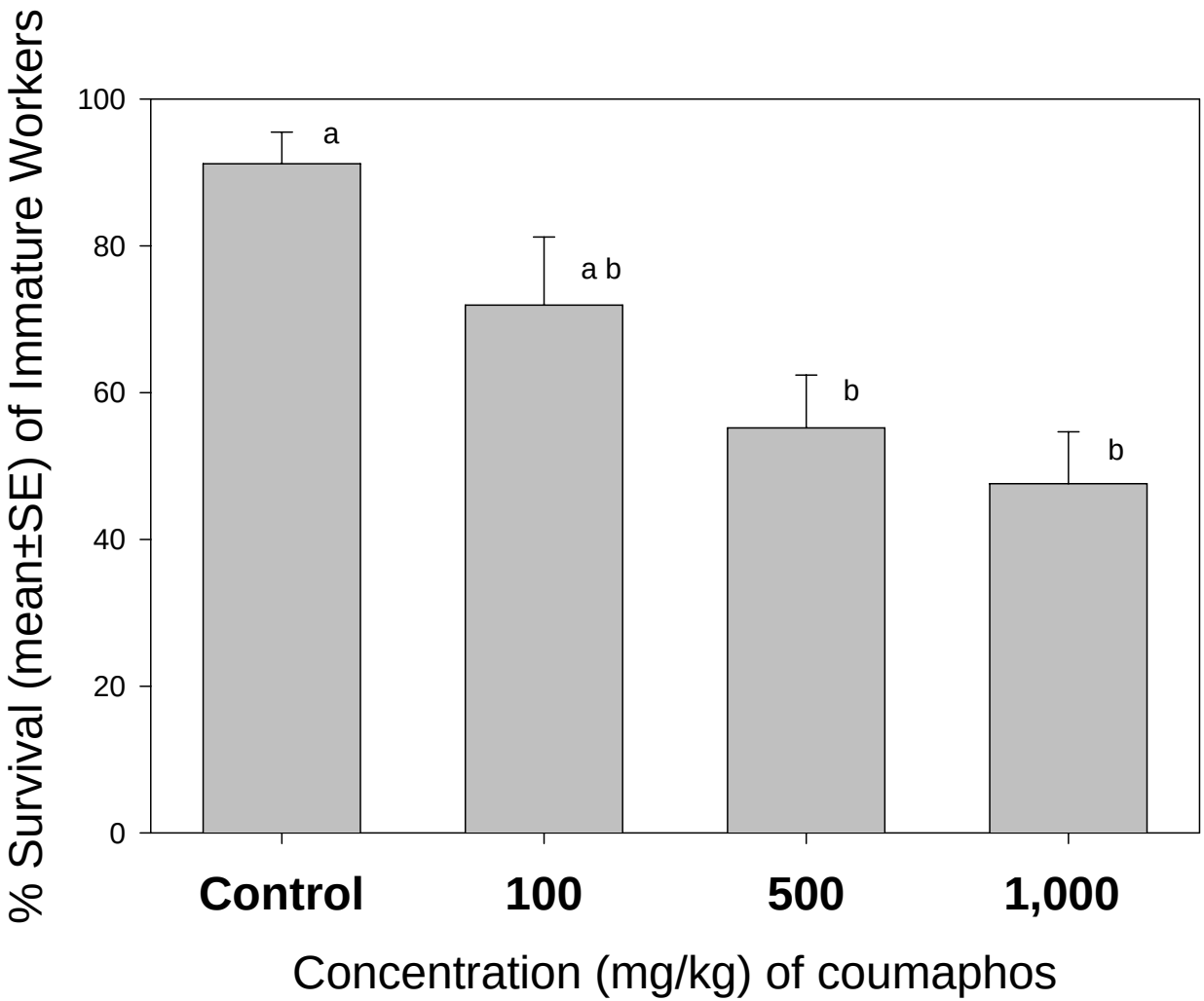

335

Pesticide Detections in Pollen % of samples with detections



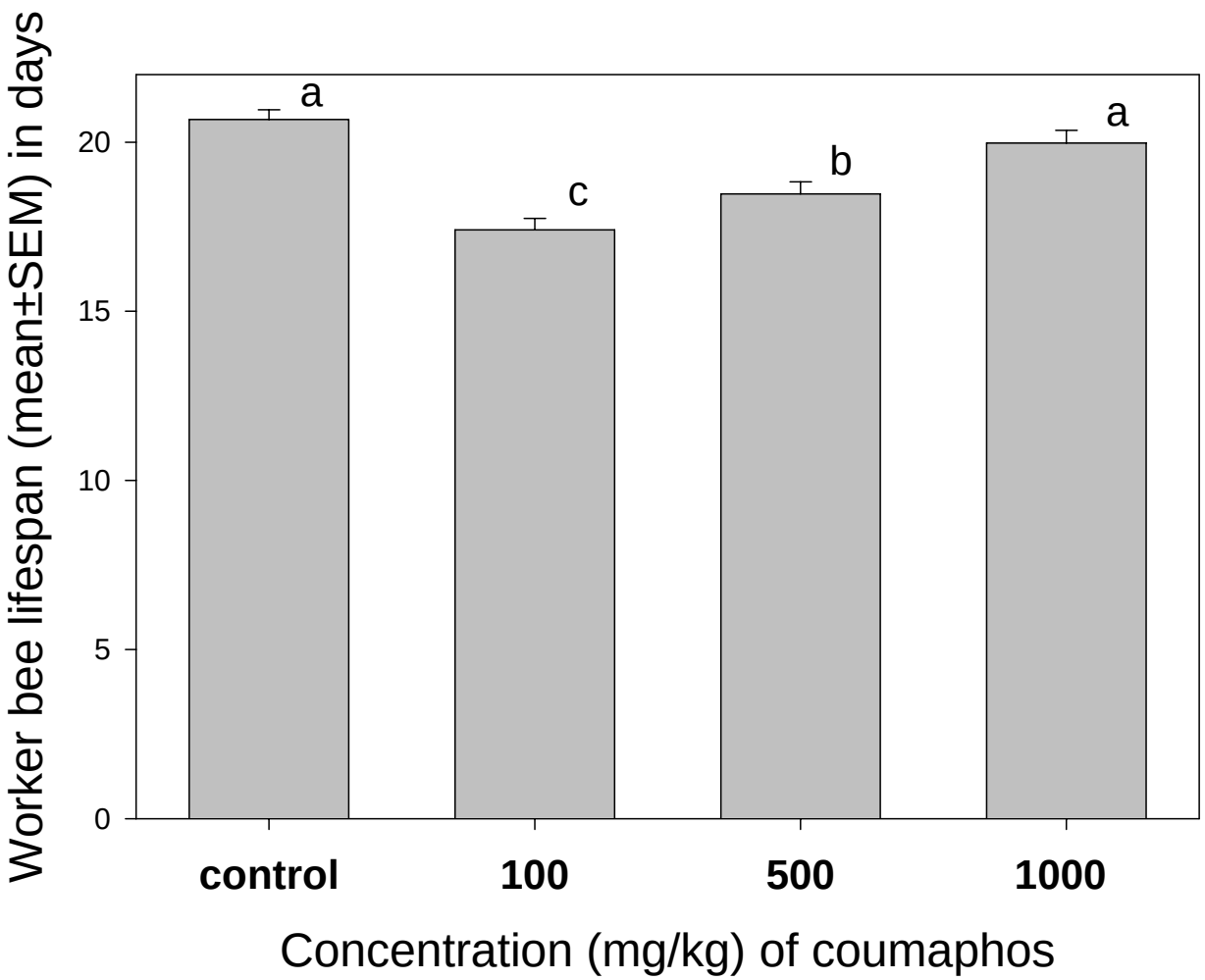

100
500
1000
Control

Survival of worker brood from 4-way comb




FLAMMABLE
INFLAMABLE
INFLAMMABLE

Lifespan of worker honey bees exposed to coumaphos during development



POLLEN

Herbicides

Carbamates

Organophosphates

Pyrethroids

Fungicides

COLONY HEALTH

Pesticide Interactions?

Sublethal Effects?

Interactions With Other Stressors?

MITE CONTROL

Fluvalinate

Coumaphos

What is happening now this fall – winter ?

Surveyed 22 operations that manage 10% of all the colonies in the U.S., plus Apiary Inspectors of America (AIA) repeated survey from 2007

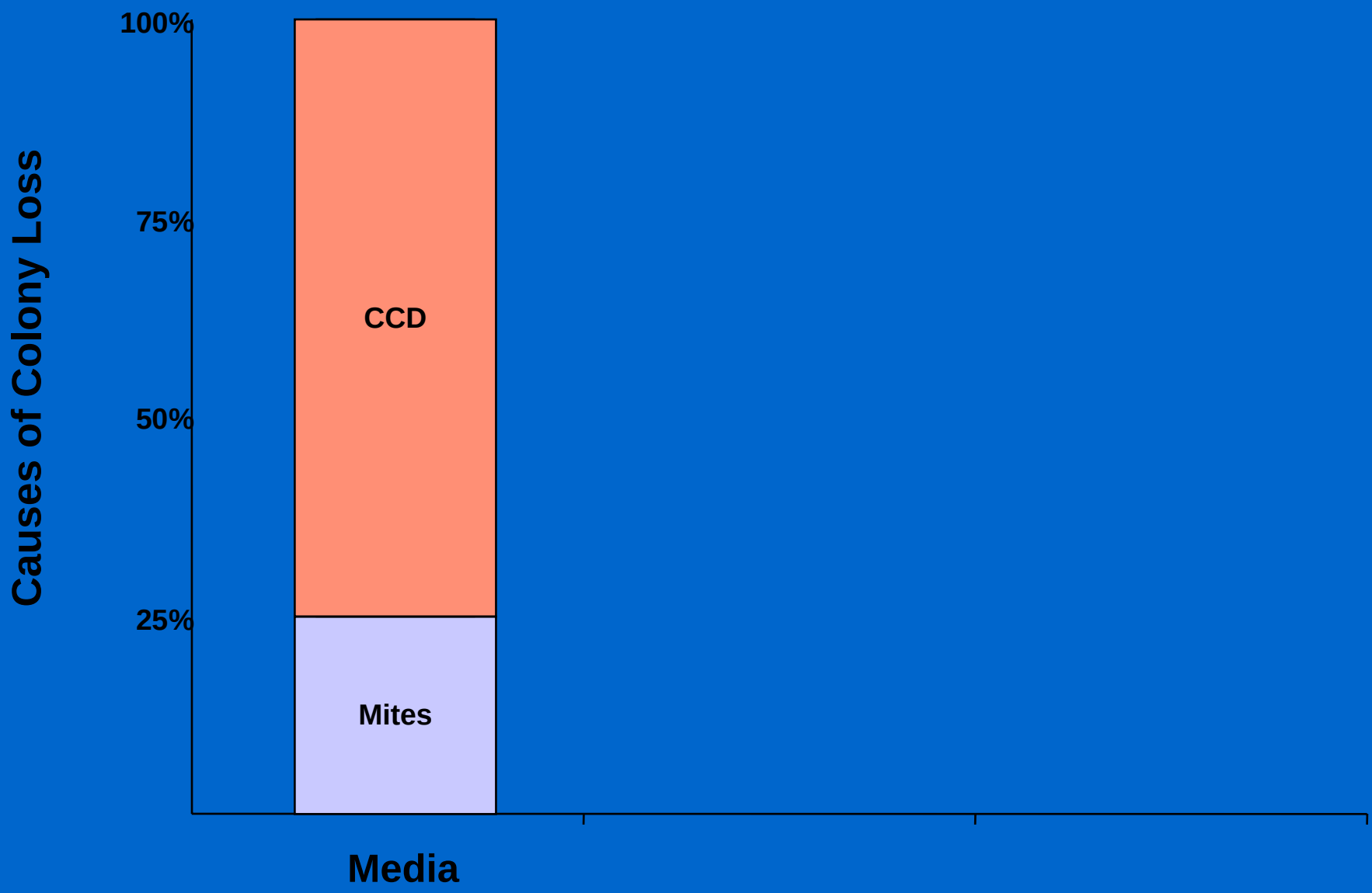
2007 AIA survey found 30% loss

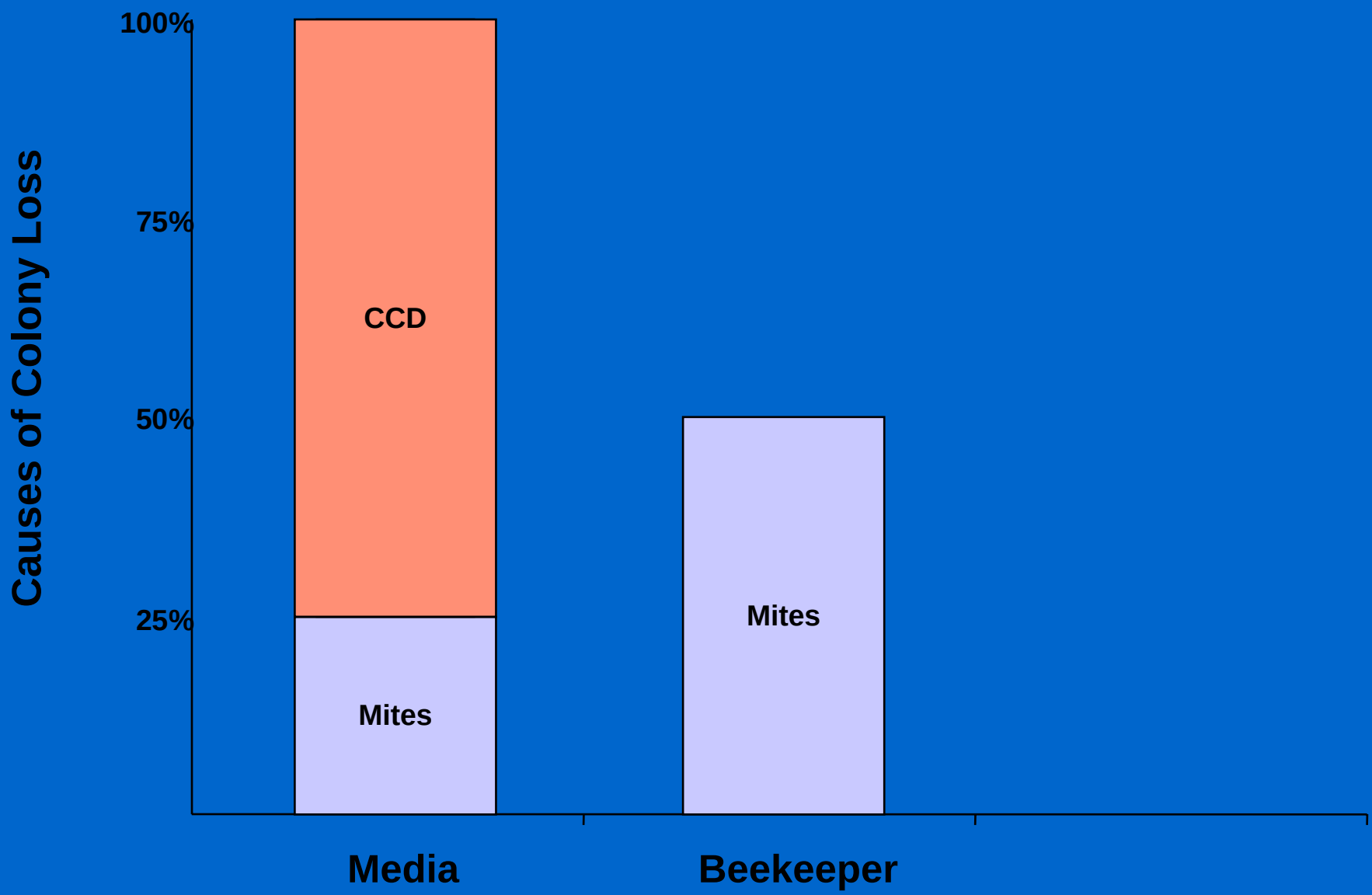
The average loss in 2008 was 35% with a range of 7% to 80%

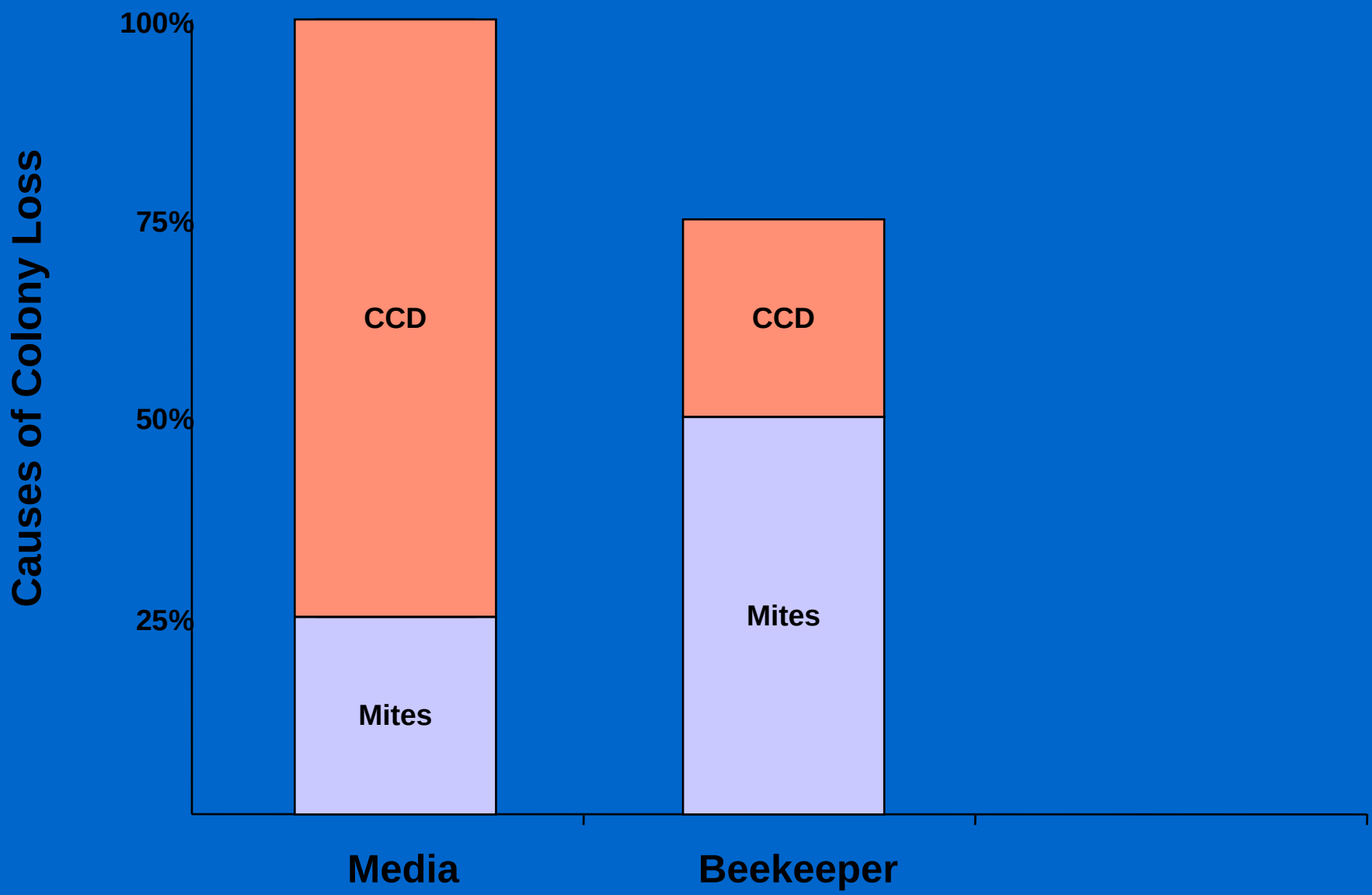
Reason for colony losses as yet undetermined

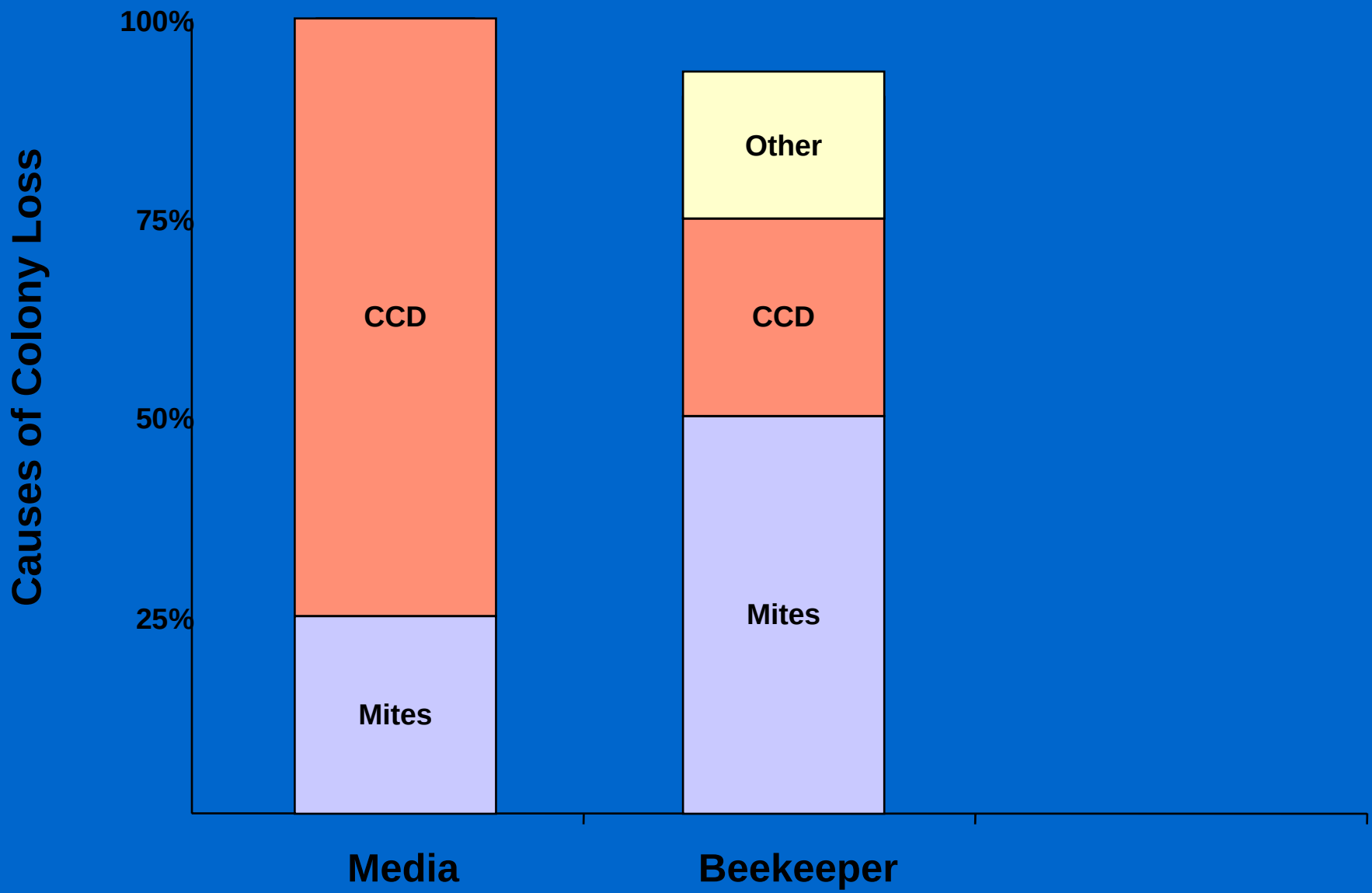
Research continues in four areas

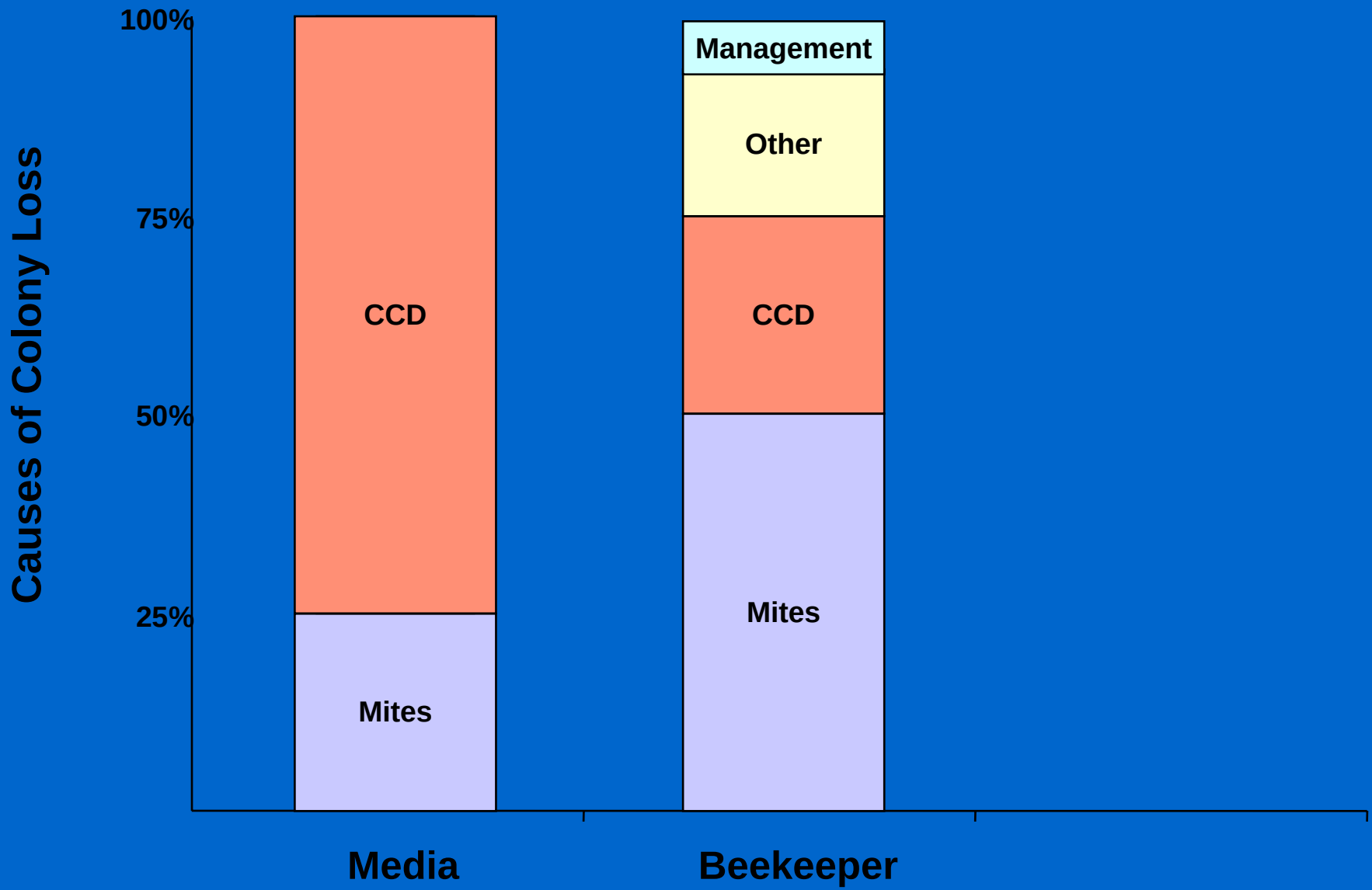
- *Stress – Nutrition, moving colonies, management*
- *Parasitic mites – Varroa and tracheal*
- *Pathogens – bacteria, fungi, viruses*
- *Pesticides – in hive mite treatments and Agricultural*

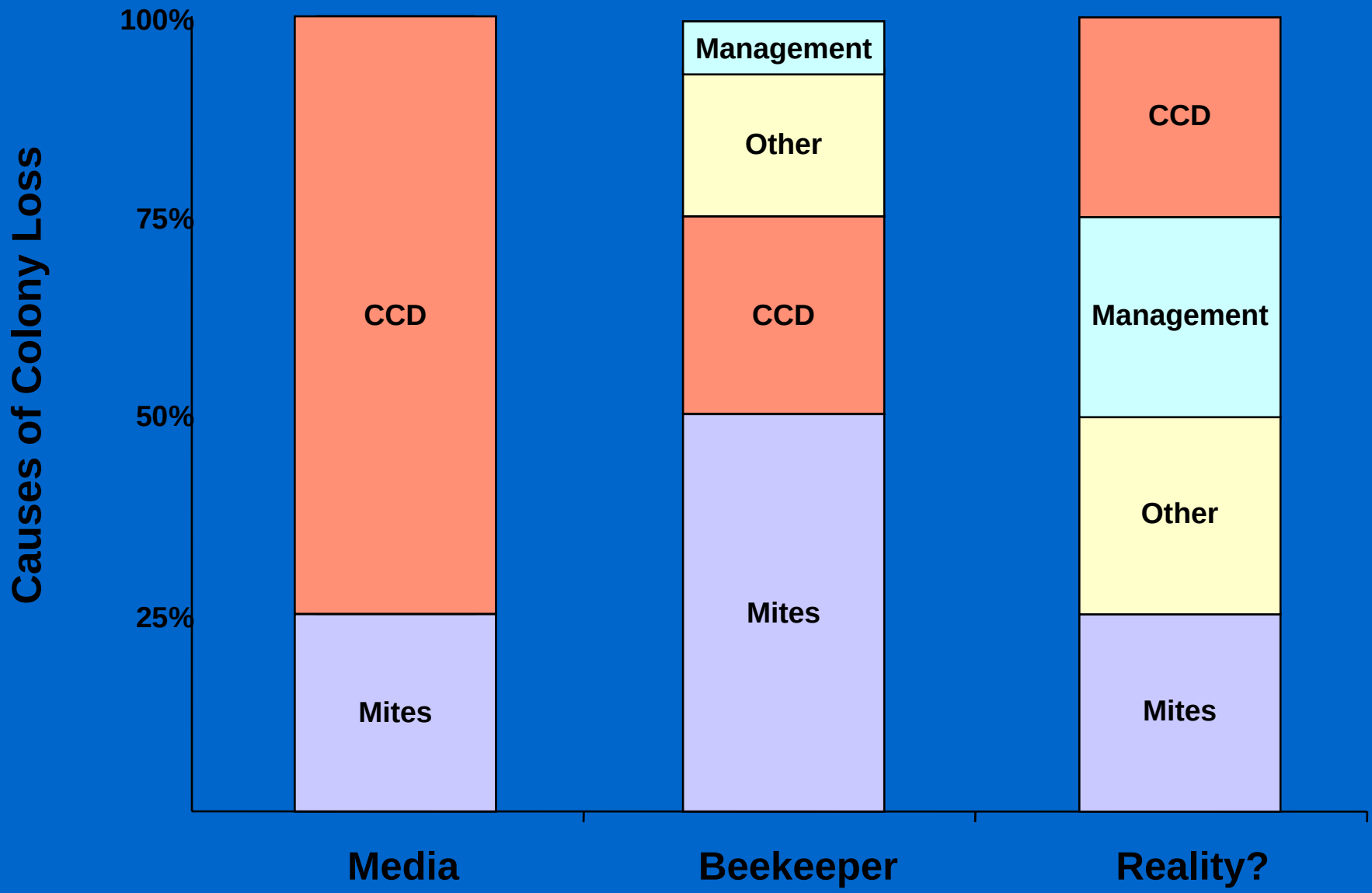

Causes of Colony Loss
100%
75%
50%
25%
CCD
Mites
Media


Causes of Colony Loss
100%
75%
50%
25%
CCD
Mites
Mites
Media
Beekeeper


Causes of Colony Loss
100%
75%
50%
25%
CCD
Mites
CCD
Mites
Media
Beekeeper


Causes of Colony Loss
100%
75%
50%
25%
CCD
Mites
Other
CCD
Mites
Media
Beekeeper


Causes of Colony Loss
100%
75%
50%
25%
CCD
Mites
Management
Other
CCD
Mites
Media
Beekeeper


Causes of Colony Loss
100%
75%
50%
25%
CCD
Mites
Management
Other
CCD
Mites
CCD
Management
Other
Mites
Media
Beekeeper
Reality?

Honey bee health continues to decline

Crop acres continue to increase

The number of honey bee colonies remains approximately 2.5 million
35% colony losses = few reserves

The ability to feed ourselves with food produced in the U.S. should be a national security issue